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(54) Method and System for Adjusting the Brightness of a Current-Controlled or Voltage-Controlled Illuminating Means for Backlighting a Display, Specifically, for Motor Vehicles

(57) The invention relates to a method for adjusting the brightness of a current-controlled or voltage-controlled illuminating means for backlighting a display, as well as a system for implementing the method.
In order to be able to adjust the background illumination of displays with very narrowly defined brightness tolerances, after fabrication of the display a correction factor is determined as a function of the brightness of the illuminating means, this factor being used to adjust the control voltage or control current of the illuminating means.

[diagram]

The following information is taken from the documents furnished by the applicant

Description

The invention relates to a method for adjusting the brightness of a current-controlled or voltage-controlled illuminating means for backlighting a display, and to a system for implementing the method.

LCDs are frequently employed in modern operator panels to display functional states, setpoint values, and actual values. All LCDs are backlit to ensure their readability under all external lighting conditions. This backlighting is performed by lamps or LEDs.

LEDs are also commonly used to backlight individual operator buttons. The purpose here is either to display the function of the button or to aid the user in finding the right button.

One goal here is to achieve a harmonious and uniform illuminated appearance for the display. In motor vehicles in particular, brightness values lying within very strict tolerances are set in this regard for the various displays such as those for the radio, air conditioning, on-board computer, or speedometer.

LEDs or lamps, on the other hand, exhibit wide variation ranges in brightness, and as a result, the display brightness specified for the fabrication of motor vehicles is often unattainable.

The current approach to achieving the desired display brightness is to measure the illuminating means and select them according to different classes based on their luminosity.

During fabrication of the electronics, the illuminating means are then provided with different series resistors in order to achieve a uniform display brightness.

The disadvantage here is that the illuminating means and series resistors are already specified at the beginning of the display fabrication process. This approach entails an extremely high logistical expense. The possibility of errors occurring, for example, due to the installation of a different illuminating means or the incorrect resistance, cannot be excluded.

The goal of the invention is therefore to provide a method in which the background lighting for displays may be adjusted within very narrowly defined brightness tolerances without high logistical expense.

According to the invention, the goal is achieved by determining, after fabrication of the display, a correction factor as a function of the brightness of the illuminating means, this factor being used to adjust the control voltage or control current of the illuminating means.

The advantage of the invention is that the brightness of the illuminating means is adjusted to the appropriate tolerances only at the end of the production line, while retaining the same hardware. Chances of error during assembly are prevented, and the logistical expense is reduced to a minimum.

The control voltage or control current is advantageously determined by an electronic computer which accesses the correction factor from a data memory in which an assignment of the brightness of the illuminating means to the corresponding correction factor is stored. The actual brightness of the illuminating means is measured, and the corresponding measured value is fed to the electronic computer. Alternatively, the electronic computer may be supplied with a value corresponding to the mean expected brightness of the illuminating means.

By using the computer control, the brightness of the illuminating means is always adjusted to the center of the tolerance field. Any other variables affecting brightness are eliminated.

In one refinement of the invention, the control signal issued by the electronic computer is a pulse signal, the pulse width of which is adjusted as a function of the brightness of the illuminating means.

According to one advantageous embodiment of the invention, a series circuit of the illuminating means leads at one end to a fixed voltage, and is connected on the other end to a series resistor. The series resistor is connected through a transistor to the output of a first microcomputer which has a programmable memory, the brightness signal being applied to one input of the microcomputer. The programmable memory may, however, also be located outside the microcomputer.

The first microcomputer is located here within the display control device.

The first microcomputer advantageously has a diagnostics interface by which the first microcomputer may be connected to a second microcomputer which controls the brightness measurement.

The second microcomputer is advantageously a test computer.

Use of existing microcomputers significantly simplifies implementation of the invention.

The invention allows for a plurality of embodiments. One of these will be explained in greater detail based on the figures of the drawing.

Figure 1 shows the adjustment of brightness using prior art.

Figure 2 shows a system for adjusting LCD backlighting.

Figure 3 shows a system for adjusting button backlighting in the case of locator lighting.

In all figures, the same features are provided with the same reference characters.

The invention will now be explained in greater detail using the example of displays in motor vehicles.

Figure 1 illustrates the current conventional adjustment of brightness for the backlighting of buttons. Three LEDs 1, 2, 3 are connected to series resistor 4 between terminal 58g of the vehicle and ground. By mounting the LEDs and series resistor, the brightness of the background illumination is permanently fixed and may not longer be corrected.

In Figure 2, a transistor 5 is connected between series resistor 4 and ground, the base of the transistor being connected to the input 14 of a microcomputer 7. Microcomputer 7 is connected through bus lines both to a nonvolatile memory (EEPROM) and to a diagnostics interface 9. Microcomputer 7, memory 8 and interface 9 are located in a control device 6 which is in turn contained in a display device 10 to control an LCD display 11.

Figure 2 illustrates only those features required to explain the invention.

Light-emitting diodes 1, 2, and 3 here are placed behind LCD display 11.

Any number of LCDs 1, 2, and 3 may be installed during fabrication of display device 10. After completion of display device 10, the luminosity of LEDs 1, 2, and 3 may

be adjusted during an end-of-line inspection using a test computer 12, preferably, an existing production computer.

To this end, the luminosity emitted by the LEDs is measured by a photometer 13, and the measurement value sent via an ND[1] converter to test computer 12. This test computer 12 is in turn connected to the diagnostics interface 9 of control device 6, the connection being readily implemented using a diagnostics connector. The digitized brightness measurement value is thus sent to characterized in 7 of control device 6.

The computer then compares the brightness value against a table stored in the EEPROM 8 in which a defined pulse width for a given driving signal of transistor 5 is assigned to each possible brightness value.

Based on this PWM signal applied at the output 14 of microcomputer 7, transistor 5 is clock-pulse controlled, resulting in a change in the voltage of LEDs 1 to 3 and hence a change in the brightness of the light-emitting diodes.

The PWM signal is thus permanently adjusted and remains intact for the life of the LEDs.

If replacement of the lamps is required, it is always possible to employ the diagnostics computer in the manner described to set a new clock-pulse relationship.

The correction values stored in EEPROM 8 may be determined from tables. If sufficient memory capacity is available, the dependence of a PWM signal on brightness may also be possible in the form of characteristics maps which allow for greater precision in the adjustment to the luminance characteristics of LEDs as measured by point-type determination.

The variable adjustment of brightness for backlighting an LCD display as described above may also be applied to backlighting individual buttons.

In the case of so-called locator lighting used to aid the user in locating a button, a possible approach is to have the LEDs or lamps assigned by microcomputer 7 to a fixed class stored in the EEPROM 8 according to their measured variations in brightness. If the brightness value falls into this class, transistor 5 is triggered – otherwise transistor 5 is not triggered.

As Figure 3 illustrates, a resistor combination composed of resistors 4 and 15 is required for this adjustment of brightness. Resistor 15 here is shorted through transistor 5 when a signal is applied.

It should also be pointed out that the principle according to the invention may also be applied to the function illumination of buttons, signaling when a button is in the ON position.

Here the LEDs with so-called Low-Side switches are connected to a constant voltage source or current source. Transistor 5 controlled by microprocessor 7 is connected in the known manner to the current source. Here again, the clock pulse signal results in a change in voltage which induces a change in brightness in the LEDs.

Claims

1. Method for adjusting the brightness of a current-controlled or voltage-controlled illuminating means for backlighting a display, specifically, for motor vehicles,

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[1] *Sic* – should probably be "AD" converter. Translator's note.

characterized in that a correction factor is determined as a function of the brightness of the illuminating means, by which factor the control voltage or control current of the illuminating means is adjusted.

2. Method according to Claim 1, characterized in that the control voltage or control current of the illuminating means is determined by an electronic computer which accesses the correction factor from a data memory in which an assignment of the brightness of the illuminating means to the corresponding correction factor is stored.

3. Method according to Claims 1 and 2, characterized in that the actual brightness of the illuminating means is measured, and the corresponding measurement value is supplied to the electronic computer.

4. Method according to Claims 1 and 2, characterized in that a value corresponding to the mean expected brightness of the illuminating means is supplied to the electronic computer.

5. Method according to one of the foregoing Claims 2 through 4, characterized in that the control signal issued by the electronic computer is a pulse signal, the pulse width of which is adjusted as a function of the brightness of the illuminating means.

6. System for implementing the method according to Claim 1, in which a series circuit comprising a plurality of illuminating means leads at one end to a fixed voltage, and is connected at the other end to a series resistor, characterized in that the series resistor (4) is connected through a transistor (5) to an output (14) of a first microcomputer (7), which has a programmable memory (8), the brightness signal being applied to an input of the microcomputer (7).

7. System according to Claim 6, characterized in that the first microcomputer (7) is located within the display control device (6).

8. System according to Claims 6 or 7, characterized in that the first microcomputer (7) has a diagnostics interface (9) by which the first microcomputer (7) may be connected to a second microcomputer (12) which controls the brightness measurement.

9. System according to Claim 8, characterized in that the second microcomputer (12) is a test computer.

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2 pages of drawings attached

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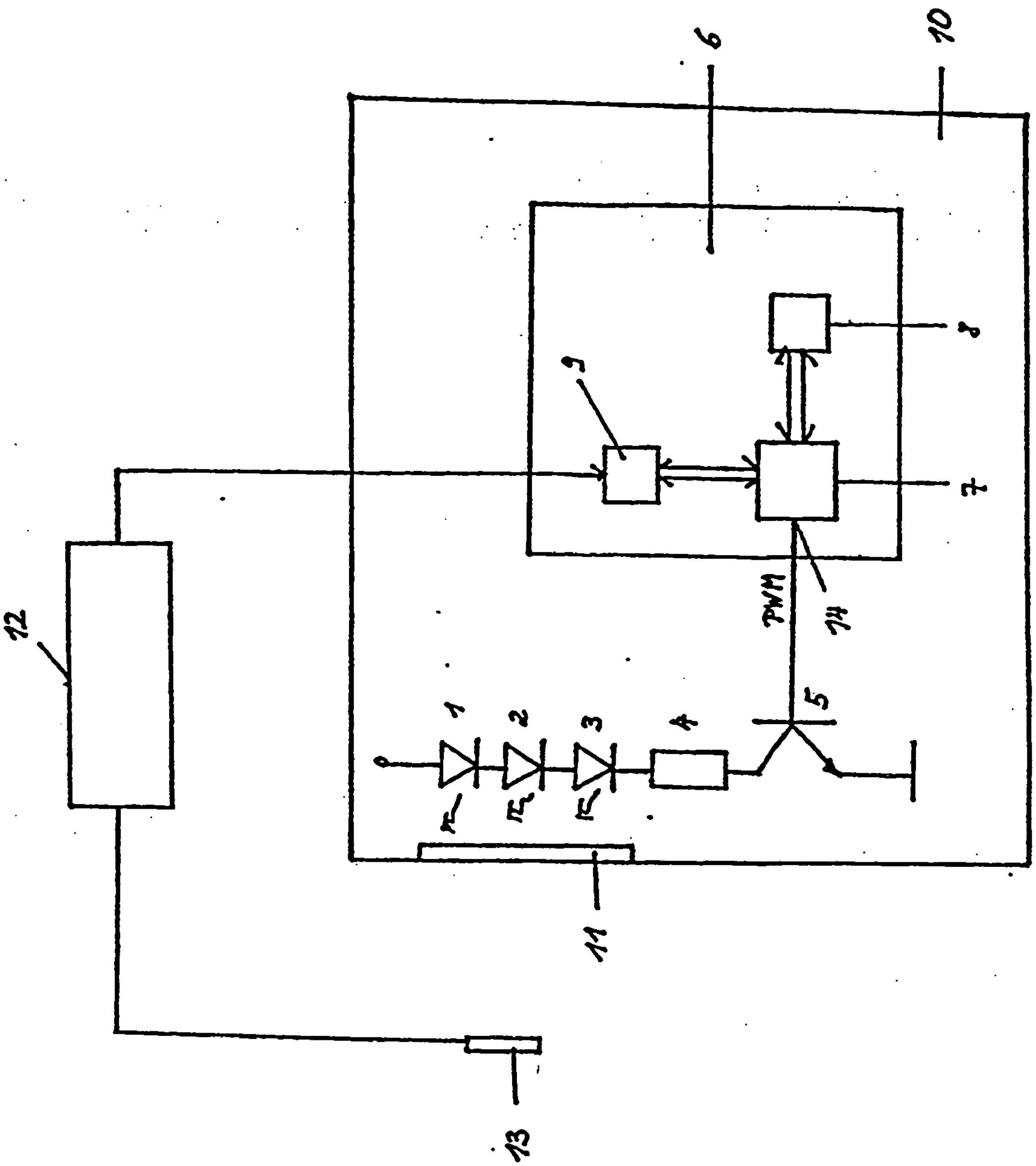
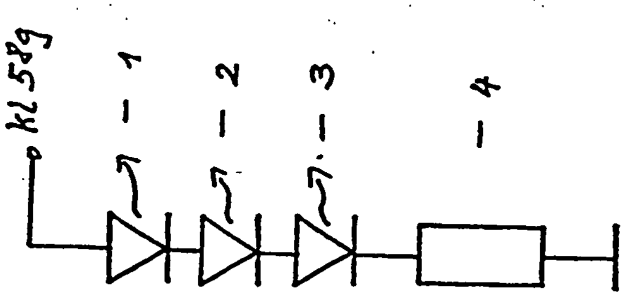


Figur 2



Figur 1

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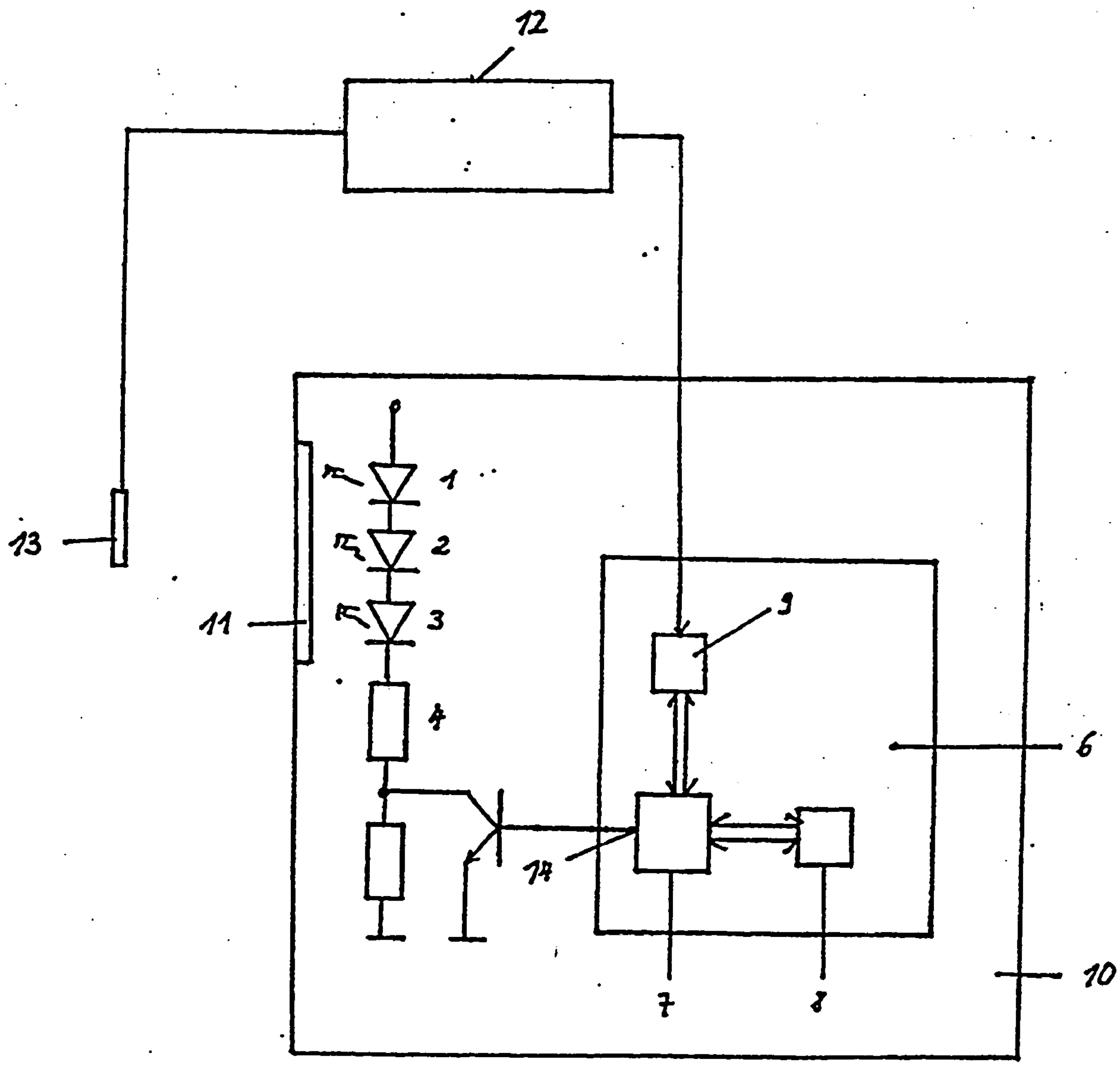

Figur 3